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The First Year's Findings in the NCA-CMI Nutrition Program

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In 1942 an extensive program to establish the nutritive value of canned foods was initiated by the National Canners Association and the Can Manufacturers Institute.* This program, which is now in the fourth year of operation, has been administered by an Executive Committee composed of five members of the technical staffs of the National Canners Association and the American and Continental Can Companies.

The urgent need was recognized for more extensive and accurate information on the nutritive value of canned foods for wartime use in the planning of adequate military and civilian dietaries. Therefore, the first year's program was devoted to the establishment of the nutritive values of canned foods as now manufactured and to the effect of small and large scale preparatory methods upon certain vitamins in such products. Seven papers describing the results of the first year's work have been published and five of these papers appear in the August, 1944, number of the Journal of Nutrition, the official organ of the American Institute of Nutrition. These five papers describe the sampling procedure followed in collection of the samples; the ascorbic acid, carotene, thiamine, niacin, riboflavin, and pantothenic acid contents found in the products studied; and the distribution of ascorbic acid, thiamine and riboflavin between the solid and liquid can contents in the case of products packed in brine or syrup.

Sampling Program

Thirty-two different products (1) used in quantity by the Armed Forces and the civilian population were collected and a total of 823 samples of these foods were assayed for the vitamins mentioned. The products studied included the fruits: apricots, grapefruit (segments and juice), orange juice, peaches, pears, prunes and pineapple (slices and juice); canned vegetables studied included asparagus (green and white), baked beans, green and lima beans, beets, carrots, whole grain corn (white and yellow), peas (sweet and Alaska), spinach, tomatoes and tomato juice. A limited number of fish products—mackerel, salmon, sardines (oil and sauce styles), shrimp and tuna—were also included.

In the sampling procedure, every attempt was made to secure samples for vitamin assay which would be representative of the canned foods purchased by the Army and Navy or the consuming public. Retail and institutional size cans of each product were obtained from factories located in the major producing areas of the United States, provision being made to collect the fruit and vegetable samples during the early, middle and late periods of the canning season in each area. For the retail can sizes, vitamin determinations were carried out on a composite of cans collected at any one sampling.

From both the number of products included and the number of vitamin assays run, this work has been described in official nutrition circles as the most thorough and complete investigation of its kind ever undertaken on any class of processed foods.

Results of Vitamin Assays

The ascorbic acid (vitamin C) and carotene (provitamin A) analyses were performed at the Arizona Agricultural Experiment Station (2). Briefly summarized, canned orange juice and grapefruit juice proved to be the best sources of ascorbic acid (averaging 39.4 and 33.8 mg. per 100 ml., respectively). Grapefruit segments packed in syrup were also found to be a rich source (averaging 24.6 mg. per 100 gm.). Other products important in ascorbic acid content were tomatoes, tomato juice, aspara-

* A report of progress on this new program was published as a supplement to N.C.A. Information Letter No. 995, on July 22, 1944.

gus (both green and white), and spinach, ranging in average values from 16.5 to 11.4 mg. per 100 gm. The richest sources of carotene prove to be carrots, spinach and apricots, while canned salmon and sardines were richest among the fish in vitamin A activity. Other products which have a substantial carotene content are prunes, tomatoes and tomato juice.

The determinations of thiamine and niacin, two of the vitamins in the B complex, were made at the University of Wisconsin (3). It was found that peas and asparagus were, among the vegetables, the best sources of thiamine, while among the fruits, pineapple slices and orange juice were found to be fair sources of this vitamin. However, the tests reaffirmed the fact that the fruits and vegetables, raw or canned, are not richly endowed by nature with thiamine.

The best sources of niacin were the fish products—tuna, mackerel, salmon, sardines and shrimp. They contained on the average, in the order of importance, from 10 to 1.4 milligrams of the vitamin per hundred grams of the products. One interesting point disclosed was that in the amounts usually or conveniently consumed, vegetable and fruit products, such as peas and peaches, also contribute substantial amounts of niacin to American diets.

The "B" vitamins, riboflavin and pantothenic acid, were determined by the University of Texas Biochemical Institute Laboratories (4). For both these vitamins, fish products were again the best sources among the food studied. Asparagus, peas and corn were found to be fair sources of pantothenic acid, while asparagus, peas and spinach were rich amongst the vegetables in riboflavin content.

The assay values from these three papers have for convenient reference been assembled in Tables I and II. The number of samples of each product collected for analysis has also been indicated in these tables. To aid in studying the data the daily allowance for these vitamins recommended in May, 1941, by the Food and Nutrition Board of the National Research Council for moderately active adults are given below:

Ascorbic acid (Vitamin C)—75 milligrams
Vitamin A—5,000 International units *
Thiamine (Vitamin B_1)—1.8 milligrams
Niacin (Nicotinic acid)—18 milligrams
Riboflavin (Vitamin B_2 or G)—2.7 milligrams
Pantothenic acid—no recommendation

It is evident from the data obtained by the three universities that a considerable variation in the vitamin content of a given food is to be expected, but it remains to be determined what factors principally account for the fact that we now find, in certain samples, several times as much ascorbic acid, thiamine or some other vitamin factor as in other samples of the same product. Is this due largely to variation in the raw material, to methods of handling, or to certain canning procedures? The data suggest to the industry the importance of "improvement studies" directed toward raising the average vitamin contents of certain products now considered as "good" sources, and increasing the vitamin contents of others now in a border-line class to the point that they also might become "good sources" of certain vitamins. Such special studies have been and are being conducted as a part of this research program.

* 1,000 International units equal 0.6 of a milligram of Beta-carotene or 1,000 international units equal 0.3 of a milligram of vitamin A alcohol.

Distribution of Water-Soluble Vitamins

The last paper (5) in the series represents work done at the University of Chicago on the distribution of the water-soluble vitamins—ascorbic acid, thiamine and riboflavin—between the solid and liquid portions of the canned fruits and vegetables. For some years it has been known that the brine or syrup in which certain canned products are packed contains vitamins extracted from the solid food material, and students of nutrition have consistently urged the utilization by the housewife of such brines or syrups. The present studies reaffirm the desirability of using the liquid from the can. In general, the solids of the canned vegetables comprise 60 to 73 per cent of the total can contents. These solids contain 46 to 68 per cent of the total ascorbic acid, 62 to 72 per cent of the total thiamine, and 70 to 80 per cent of the total riboflavin, the remaining amounts of these vitamins being found in the fluid portion of the can contents. In fruits the solids comprise 46 to 67 per cent of the total can content. These solids contain 49 to 68 per cent of the total ascorbic acid, 50 to 70 per cent of the total thiamine, and 53 to 69 per cent of the total riboflavin, the remaining amounts of these vitamins being found in the fluid portion of the can contents.

Vitamin Retention during Preparation for Serving

In the December, 1944, and January, 1945, issues of the Journal of the American Dietetic Association two additional papers (6, 7) appeared, which deal with the effect of large and small scale food preparatory methods on the ascorbic acid, thiamine and riboflavin content of commercially canned vegetables. This work, which was also performed at the University of Chicago, was carried out on eight vegetables and two different styles of baked beans. The vegetable products included were identical with those used in the studies previously described. To

study the effect of large scale food preparatory operations, the procedure followed closely approximated that utilized in the mess kitchens of Army posts. In the small scale preparatory studies, two different methods were investigated. In the first of these, that recommended by the Home Economics Department of the National Canners Association, the liquid and solid portions of the cans were heated and served together; in the second method, only the solid portion of the food was served.

The results of the large scale preparation tests have proved of value in the calculation of diets for Army garrisons and posts. The effect on each of the three vitamins brought about by the two methods used in the small scale methods, such as a housewife might employ, was variable; but, in general, the method recommended by the National Canners Association proved superior. Of the three vitamins considered, the most variable effects were found in the case of ascorbic acid, where the retention of this vitamin in the prepared food varied between 44 and 94 per cent for the approved method and 20 and 58 per cent for the other method studied. In the case of canned tomatoes, the retention of ascorbic acid during the preparation was practically complete. These studies materially add to the knowledge of canned foods and should be particularly useful to practicing home economists and dietitians.

During the current year it is expected that other papers representing work completed in the second and third years of the program will appear. The current paper shortage has precluded obtaining as many reprints of the seven papers thus far published as had been requested. A limited number of reprints, however, are available for the use of those who require more detailed or specific information. Such reprints may be obtained by addressing the National Canners Association, Washington 6, D. C.

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TABLE I.—VITAMIN CONTENT OF SOME COMMERCIALLY CANNED SEA FOODS

(Mg. per 100 gm.)

Foods	No. of plants sampled	No. of samples collected	Vitamin A Alcohol	
			Ranges	Avg.
Mackerel	8	9	0.015–0.054	0.029
Salmon, pink	2	2	.015– .023	.019
Salmon, red	3	3	.078– .102	.087
Sardines, in oil	5	5	.021– .123	.069
Shrimp, dry pack	3	3	.014– .023	.017
Shrimp, wet pack	5	5	.015– .022	.018
Tuna	6	6	.005– .010	.008

TABLE II.—VITAMIN CONTENT OF SOME COMMERCIALLY CANNED FOODS

(mg. per 100 gm. or 100 ml.)

Foods	No. of plants sampled	No. of samples collected	Ascorbic Acid		Carotene		Thiamine		Niacin		Calcium Pantothenate		Riboflavin	
			Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.
Apricots, unpeeled halves	8	21	1.1– 5.7	3.9	0.93–1.74	1.28	0.008–0.026	0.019	0.20– 0.48	0.37	0.045–0.20	0.095	0.012–0.039	0.024
Asparagus, all green	15	31	5.4–25.3	15.2	.22– .50	.31	.040– .122	.067	.22– 1.19	.85	.072– .43	.19	.039– .19	.096
Asparagus, culturally bleached	4	12	11.6–18.1	14.9	Trace– .06	.03	.043– .055	.050	.63– .88	.75	.092– .16	.12	.044– .073	.058
Beans, baked, New England Style	3	3	1.9– 4.3	2.9	Trace– .05	.02	.015– .027	.021	.15– .32	.24	.061– .11	.081	.051– .059	.054
Beans, with tomato sauce	2	2	1.8– 3.5	2.7	.04– .06	.05	–	.053	–	.91	.092– .11	.10	.019– .029	.024
Beans, green cut	23	73	.6– 7.3	3.2	.08– .34	.18	.011– .053	.029	.18– .60	.32	.023– .11	.061	.018– .065	.034
Beans, lima, green	14	27	2.5–12.1	7.0	.03– .18	.07	.019– .048	.032	.32– .77	.55	.068– .17	.11	.023– .062	.042
Beets	9	27	Trace– 4.0	2.0	Trace– .05	.006	.004– .014	.008	.06– .28	.13	.045– .12	.076	.011– .059	.025
Carrots	7	19	1.0– 4.6	2.0	4.47–9.44	7.16	.013– .027	.021	.19– .49	.34	.093– .21	.13	.009– .042	.021
Corn, white, whole kernel	15	46	2.0– 6.5	4.4	Trace– .11	.02	.010– .039	.021	.46– 1.50	.88	.10 – .50	.18	.027– .064	.043
Corn, yellow, whole kernel	24	61	1.3– 8.0	4.2	.04– .16	.09	.014– .045	.026	.53– 1.06	.77	.094– .32	.21	.025– .072	.044
Grapefruit juice	20	43	26.3–44.7	33.8	Trace– .02	.007	.012– .050	.025	.08– .49	.17	.065– .17	.12	.010– .033	.019
Grapefruit segments	10	24	20.3–32.3	24.6	Trace– .02	.009	.007– .046	.026	.13– .35	.21	.063– .19	.13	.008– .039	.021
Mackerel	8	9	–	–	–	–	.021– .045	.034	4.01–11.4	7.82	.13 – .48	.29	.13 – .29	.20
Orange juice	8	15	33.0–52.4	39.4	.01– .12	.08	.033– .103	.072	.18– .30	.25	.081– .17	.12	.012– .038	.022
Peaches, clingstone, halves	9	17	2.0– 5.7	3.9	.19– .51	.26	.005– .011	.007	.48– 1.18	.70	.017– .065	.041	.013– .030	.022
Peaches, freestone, halves	11	13	1.4– 3.7	2.3	.09– .28	.16	.005– .011	.008	.34– .90	.57	.020– .13	.052	.009– .034	.021
Pears, halves	15	30	Trace– 2.5	1.5	Trace– .002	–	.005– .012	.009	.06– .28	.13	.008– .041	.022	.009– .032	.019
Peas, Alaska	2	7	7.4–13.7	10.0	.21– .31	.25	.085– .121	.099	.68– 1.04	.80	.069– .18	.13	.037– .064	.049
Peas, sweet (wrinkled varieties)	26	92	3.1–13.8	8.8	.15– .51	.26	.056– .188	.115	.42– 2.69	1.06	.081– .26	.15	.025– .10	.054
Pineapple juice	8	18	3.2–14.2	8.5	.01– .04	.03	.031– .070	.052	.16– .20	.18	.066– .18	.10	.004– .031	.018
Pineapple, sliced	8	17	.8– 7.0	5.1	.01– .04	.03	.053– .087	.070	.12– .20	.17	.053– .15	.10	.006– .030	.021
Prunes, Italian	5	10	Trace– 3.0	1.1	.44– .89	.63	.017– .039	.024	.19– .47	.36	.027– .085	.044	.019– .032	.026
Salmon	5	5	–	–	–	–	.014– .038	.021	5.95– 8.91	7.81	.47 – .73	.57	.14 – .17	.16
Sardines, in oil	5	5	–	–	–	–	.014– .042	.024	2.92– 7.15	5.57	.44 – .65	.53	.09 – .15	.11
Sardines, in tomato sauce	10	10	–	–	–	–	.007– .016	.010	2.36– 5.40	3.93	.41 – .58	.47	.12 – .23	.18
Shrimp, dry pack	3	3	–	–	–	–	.006– .011	.009	1.10– 3.40	2.23	.26 – .35	.29	.027– .037	.032
Shrimp, wet pack	5	5	–	–	–	–	.004– .011	.008	.72– 2.52	1.36	.18 – .22	.21	.026– .035	.031
Spinach	19	31	3.4–25.9	11.4	1.68–4.81	3.16	.009– .041	.020	.16– .64	.30	.021– .14	.051	.024– .13	.082
Tomatoes	26	63	9.5–27.1	16.3	.35– .96	.58	.019– .077	.049	.41– .97	.69	.11 – .44	.23	.011– .050	.028
Tomato juice	30	79	2.5–25.2	12.9	.16– .96	.51	.014– .063	.049	.55– 1.77	.75	.17 – .39	.25	.009– .046	.028
Tuna	6	6	–	–	–	–	.016– .082	.037	7.60–13.0	10.2	.13 – .19	.17	.11 – .17	.14